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ABSTRACT

A test, developed to measure important skills in fourth-grade mathematics, was given to a representative sample of about 8,000 fourth-grade students in Oregon in February 1976. In the first section of this document, findings and interpretations of the test data are reported briefly for five mathematics content domains: geometry; arithmetic; numeration, variables, and symbols; measurement; and probability and statistics. The second section of the document covers findings and interpretations of the data for four reporting variables: characteristics relating to student diagnosis and participation in corrective/remedial programs; mathematics program/teacher characteristics; student characteristics; and district characteristics. The third section lists recommendations based upon analyses of results. The fourth section gives interpretations and recommendations for ten other subject areas: language arts, career education, art, consumer education/personal finance, social studies/history physical education/health science, and citizenship. Appendices include the objectives for the five content domains, and a list of which of these objectives apply to each of the ten other subject areas. (DT)

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EDUCATION FOR OREGON LEARNERS: WHERE WE STAND

Results Of The 1976 Assessment Of Mathematics

ED139664

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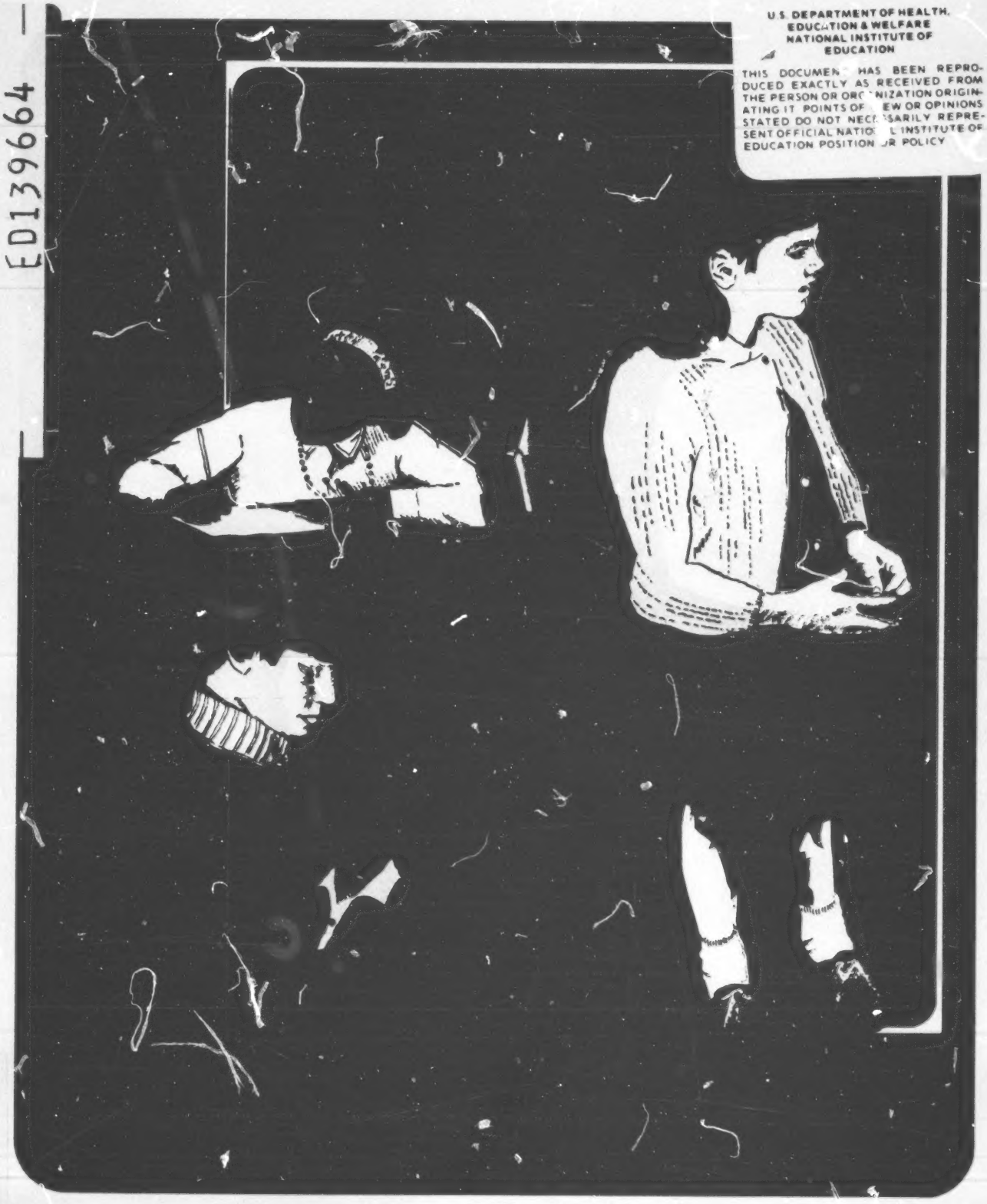

SE 022 559

EDUCATION FOR OREGON LEARNERS: WHERE WE STAND
RESULTS OF THE 1976 ASSESSMENT OF MATHEMATICS

December 1976

Oregon Department of Education
942 Lancaster Drive NE
Salem, OR 97310

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Oregon Department of Education

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FOREWORD

The planning stages of this assessment program began several years ago. The program was responsive to the needs of educational decision-makers at that time. In June 1976, the Minimum Standards for Public Schools were adopted. They called for some changes in our educational system. As a result of these changes, new kinds of information will be needed. Of particular importance will be information about students' achievement of basic skills as they are developed and applied in other areas of study. The assessment program was not originally designed to gather information about basic skills achievement in other areas of study; however, the Department has tried to glean as much useful information as possible from the results of this assessment.

My staff is grateful to those who served on development and interpretation panels and to the teachers, students and administrators who helped collect this information.

I hope that these results will be used to support continued improvement in curriculum and instruction.

Verne A. Duncan
State Superintendent of
Public Instruction

PREFACE

The Minimum Standards for Public Schools adopted by the State Board of Education on June 23, 1976, describe a process for public schools which is designed to improve education for students. If entered into with enthusiasm, the required procedures will provide local district educators with a variety of activities to help them teach more efficiently.

The relationship between curriculum/instruction and assessment must work well. Although educators sometimes forget, assessment information is collected to help us judge the propriety and efficiency of our instructional programs. The Instructional Planning section of the Standards (OAR 581-22-208) makes this relationship clear. The process of setting goals, assessing, identifying needs, and improving programs is a process of decision-making based on a comparison of what exists to what we would like to see exist. These math results indicate what exists. Joined with other information, they can be used to help us approach what we desire.

The information presented here provides an insight into the mathematics achievement of Oregon's fourth grade pupils. The data were collected in February 1976 from a representative sample of approximately 8,000 students. Assessment information is collected to help decision-makers. The test results are presented, therefore, in reference to desired achievement levels and in reference to skills needed to succeed in certain life roles and in certain areas of study. Those who determine curriculum and instruction policies will find these results useful. No claim is made, however, that these results alone, with no other information, are sufficient. Policy makers require additional relevant information--information about communities, funding, school programs, and other areas. Individual problems will call for unique kinds of information.

In The Eden Express Mark Vonnegut quotes Robert Lewis Stevenson: "It is a better thing to travel hopefully than it is to arrive." Educators and everyone touched by the educational process are all traveling hopefully. The methods we develop change so often in order to keep pace with the world we serve that we never seem to arrive. The assessment methods used to collect the information presented here will change. The Department of Education is working now to develop assessment techniques which provide information to state level personnel, teachers, parents, students and the public. And while the new techniques will themselves be of temporary use, they will mark a continuing response to the needs of the people educators serve.

We must never lose sight of the fact that while the caravan travels hopefully, individuals join the march and, later, leave. We must make every effort to support them so that when they leave the formal educational system, they continue to travel hopefully. The ability of a state agency to do this directly is limited. Only through the joint efforts of the state agency and local districts can we hope to serve individuals. No matter how they change, the Minimum Standards and related assessment activities should continue to describe this relationship and to emphasize service to people.

In closing, I would like to acknowledge those present and former staff members who contributed to this assessment project--Mary Hall, James Impara, Marshall Herron, Henry Dizney, John Major, Teresa Brownell, Helen Dewar and co-authors Carol Meyer and Barbara Schmidt.

Gordon Ascher, Director
Planning, Evaluation and Assessment

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HIGHLIGHTS

According to the February 1976 statewide math assessment, fourth grade student performance was judged satisfactory or better on 17 out of 28 performance indicators identified by Oregonians as important. Student performance was measured in the following domains: geometry; arithmetic; numeration, variables and symbols; measurement; and probability and statistics.

In which domain did fourth grade Oregon students appear strongest?

- Geometry skills.

In which domain did fourth grade Oregon students appear weakest?

- Numeration, variables, and symbol skills. (one domain)

Which groups performed above the state average?

- Fourth graders who had not previously repeated a grade.
- Whites.

Which groups performed below the state average?

- Students diagnosed as needing corrective/remedial work in math.
- Students diagnosed as having a reading problem.
- Students who had failed a grade or been held back.
- Members of minority groups.
- Some bilingual students.

Which reporting variables revealed very little or no significant differences in performance?

- Sex of the student.
- Amount of time per day in formal math instruction (16-30 minutes, 31-45 minutes, 46-60 minutes).
- Geographic region.
- District size.
- District per pupil expenditure.
- Teacher preservice/inservice training in the last two years.
- Students being new to a district.

Some other important findings of this year's assessment:

- Students diagnosed as needing corrective/remedial work in math were more likely boys, minority students, older students, students who previously failed a grade, students new to the district, students who were participating in remedial math or Title I ESEA programs.

- Approximately 12 percent of Oregon fourth graders (3,800 students) are participating in corrective/remedial math programs.

- Another eight percent of the students (approximately 2,600) have been diagnosed as needing corrective/remedial help in math and are not receiving it.

- Fourteen percent or 4,700 students who scored substantially below the state average on the math assessment instrument had diagnosed problems in both math and reading.

Can data from this assessment be used in examining math skills developed and/or applied in other areas of study or in preparation for life roles?

- If such statewide measures for math skills related to other areas of study or life roles are desired or needed, then assessment instruments designed for those purposes should be constructed and administered and their results analyzed. Some preliminary interpretations, however, are still possible. An exploratory look at this kind of information is described in the final section of this report.

CONTENT DOMAINS - FINDINGS AND INTERPRETATIONS

The Fourth Grade Oregon Statewide Math Assessment was developed on a foundation of five content domains. These were further delineated by twenty-eight performance indicators (skills). These performance indicators were judged to be essential by over 400 Oregon educators and other citizens. The complete descriptions of the content domains and performance indicators appear in the Appendix of this report. The five content area domains are listed below, in addition to the number of performance indicators within each domain:

1) Geometry Skills - (7 Performance Indicators)
2) Arithmetic Skills - (7 Performance Indicators)
3) Numeration, Variables, Symbols Skills - (6 Performance Indicators)
4) Measurement Skills - (5 Performance Indicators)
5) Probability and Statistics Skills - (3 Performance Indicators)

Nationally standardized tests were not toally appropriate for measuring what Oregonians regarded as important in fourth grade math. Consequently, a new test unique to Oregon was assembled to measure the above domains and performance indicators. The assessment staff, with the assistance of a content panel of teachers and math specialists, was responsible for item and test development. An 100-item math test was administered to a scientific sample of 7,769 fourth graders in 207 schools during the week of February 23-27, 1976.

Subsequently, a panel of Oregon citizens and educators was asked to set the standards (criterion levels) by which student performance on the Fourth Grade Oregon Statewide Math Assessment could be judged. The interpretive panel composed of forty-five mathematics specialists, classroom teachers, and administrators met in Salem from June 28 to July 2, 1976, to discuss its expectations for student performance. These educators utilized their experience and knowledge of both Oregon fourth grade students and curriculum in establishing criterion levels for student performance on each item from the assessment instrument. It is recognized that others may set somewhat different criterion levels and, therefore, may make somewhat different interpretations. Readers are encouraged to examine the results for themselves and to compare their ideas and interpretations with those offered in this report.

Collectively the panel set criterion levels for satisfactory performance for individual performance indicators. Each was measured by two to six items. This was done by specifying, before an examination of the data, a satisfactory performance range for each item (i.e., upper and lower limits for the percent expected to answer an item correctly). Performance levels above the upper limit would indicate "strengths" in student performance. Performance levels below the lower limit would indicate "weaknesses" in student performance.

Following the establishment of criterion levels for all performance indicators, the panel received actual performance data. From these

data they were to judge performance as weak, satisfactory, or strong and to generate consequent interpretations and recommendations. Their interpretations and recommendations were jointly reviewed and clarified by a second panel composed of Oregon citizens and parents.

The following performance indicators and corresponding perfomance values and interpretive comments for performance indicators are presented below by content domain. (The performance values are the averaged performance values--percent of students answering item correctly--for all items corresponding to the performance indicator.)

DOMAIN I: GEOMETRY SKILLS

Performance Indicator Number 1: Geometric Concept Identification

Performance: 91.6% Interpretation: Strength

Performance Indicator Number 2: Figure Similarities

Performance: 81.5% Interpretation: Strength

Performance Indicator Number 3: Figure Differences

Performance: 81.2% Interpretation: Satisfactory

Performance Indicator Number 4: Matching Shapes

Performance: 95.9% Interpretation: Strength

Performance Indicator Number 5: Shapes in Nature

Performance: 89.2% Interpretation: Strength

Performance Indicator Number 6: Man-Made Figures

Performance: 85.6% Interpretation: Satisfactory

Performance Indicator Number 7: Finding Perimeter

Performance: 43.1% Interpretation: Weakness

Geometry Skills Domain Interpretations

Looking at the seven performance indicators in this domain, performance on four was judged as strong, on two as satisfactory, and on one as weak. The strengths were in recognizing and differentiating geometric shapes.

A specific weakness was noted in finding perimeter. Problems in this area were more complex, involving more opportunities for error, and this may have been a major factor in causing poorer performance. This was the only area involving application of geometric skills.

If the criteria set for performance with respect to perimeter are to be achieved, students should be given more opportunities to acquire the concept through "real world" experiences (manipulating real, everyday objects) before they are expected to learn the abstract concept of perimeter.

DOMAIN II: ARITHMETIC SKILLS

Performance Indicator Number 8: Multiplication Basic Facts

Performance: 90.2% Interpretation: Strength

Performance Indicator Number 9: Adding, Subtracting

Performance: 64.5% Interpretation: Weakness

Performance Indicator Number 10: Add, Subtract Money

Performance: 77.0% Interpretation: Satisfactory

Performance Indicator Number 11: Number Order in Multiplication

Performance: 83.8% Interpretation: Satisfactory

Performance Indicator Number 12: Impossible Products

Performance: 43.0% Interpretation: Satifactory

Performance Indicator Number 13: Word Problems - Addition, Subtraction

Performance: 58.5% Interpretation: Weakness

Performance Indicator Number 14: Shopping, Addition, Subtraction

Performance: 48.6% Interpretation: Weakness

Arithmetic Skills Domain Interpretations

Looking at seven performance indicators in this domain, performance on one was judged as strong, on three as satisfactory, and on three as weak. Students were strong in multiplication of one-digit numbers. They were weak in subtraction, whether in number problems, word problems, or shopping problems. They seemed to have particular difficulty in problems involving zeroes. Attention is needed in providing instruction in subtraction involving zeroes, and in providing real-life situations and simulations involving money and shopping.

DOMAIN III: NUMERATIONS, VARIABLES, AND SYMBOLS SKILLS

Performance Indicator Number 15: Math Symbol Identification

Performance: 91.6% Interpretation: Strength

Performance Indicator Number 16: Ordering Numbers

Performance: 59.1% Interpretation: Weakness

Performance Indicator Number 17: Place Value

Performance: 64.1% Interpretation: Weakness

Performance Indicator Number 18: Correct Equation Identification

Performance: 51.4% Interpretation: Weakness

Performance Indicator Number 19: Whole Number Patterns

Performance: 66.2% Interpretation: Satisfactory

Performance Indicator Number 20: Odd, Even Numbers

Performance: 72.9% Interpretation: Weakness

Numerations, Variables, and Symbols Skills Domain Interpretations

Looking at the six performance indicators in this domain, performance on one was judged as strong, on one as satisfactory, and on four as weak. Students had difficulty with the properties of numbers. These properties included zero, odd-even numbers, and place value. Students also had difficulty both in transforming word problems into mathematical operations and in identifying correct solutions to word problems.

DOMAIN IV: MEASUREMENT SKILLS

Performance Indicator Number 21: Coin Names, Values

Performance: 92.5% Interpretation: Strength

Performance Indicator Number 22: Change on Purchase

Performance: 46.2% Interpretation: Weakness

Performance Indicator Number 23: Length Measurement Units

Performance: 65.3% Interpretation: Satisfactory

Performance Indicator Number 24: Volume of Rectangular Solids

Performance: 24.9% Interpretation: Weakness

Performance Indicator Number 25: Exact Money Amount

Performance: 64.0% Interpretation: Satisfactory

Measurement Skills Domain Interpretations

Looking at the five performance indicators in this domain, performance on one was judged as strong, on two as satisfactory, and on two as weak. Students had difficulty with subtraction in a measurement setting (making change on a purchase) as they had with virtually all forms of subtraction in the test. Length measurement was only troublesome when metric units were used. Possibly due to their own life experiences, students had little difficulty with problems dealing with coins, but considerable difficulty when bills were involved. The latter situation also presents a more complex and abstract computational problem. Performance was weak in finding the volumes of rectangular solids. Students had a strong tendency to count the number of faces visible, rather than calculate the number of cubes implied, on a given figure.

DOMAIN V: PROBABILITY AND STATISTICS SKILLS

Performance Indicator Number 26: Interpreting Graphs

Performance: 65.2% Interpretation: Satisfactory

Performance Indicator Number 27: Graph Limitations

Performance: 68.6% Interpretation: Satisfactory

Performance Indicator Number 28: Making Bar Graphs

Performance: 51.8% Interpretation: Weakness

Probability and Statistics Skills Domain Interpretations

Within this domain, performance for none of the performance indicators was judged as strong, perfomance on two was judged as satisfactory, and on one as weak. Performance was satisfactory in interpreting graphs and knowing graph limitations. Practice constructing graphs, particularly those relevant to the child's immediate environment, is suggested to improve performance.

REPORTING VARIABLES - FINDING AND INTERPRETATIONS

The performance of all Oregon fourth graders on the different domains and performance indicators has been described. This section describes the characteristics and performance of subsets of students. Students were placed into these subsets based on biographical and program information provided by the teachers at the time of testing.

The characteristics describing subsets of students are called reporting variables. The reporting variables have been grouped into four major categories:

1. characteristics relating to student diagnosis and participation in corrective/remedial programs

2. math program/teacher characteristics

3. student characteristics

4. district characteristics.

The following sections provide a breakdown of student performance according to these categories.

1. Characteristics Relating to Student Diagnosis and Participation in Corrective/Remedial Programs.

Six reporting variables are included within this category. Each variable is discussed below.

a. Diagnosis of Math Problems.

Teachers were asked to identify students who had been diagnosed by a teacher or specialist as needing corrective/remedial work in math. Approximately 19 percent of the Oregon fourth graders sampled had been so diagnosed, 16 percent by teachers and three percent by specialists. Students diagnosed by teachers performed below the state average in all five content domains. Students diagnosed by specialists performed even lower. The trend of specialists diagnosing the more serious problems was also observed in the reading assessment results in 1975. Students diagnosed as having a math problem were more likely boys, minority students, older students, students who had previously failed a grade, students new to the district, students who were participating in remedial math or Title I ESEA programs.

b. Severity of Math Problems.

Teachers indicated that 8.9 percent of the sampled students had mild problems (were up to one year below grade level), 7.5 percent had severe problems (were one to two years below grade level), 1.4 percent had extremely severe problems (more than

two years below grade level), and .5 percent had problems for which the severity had not been determined. Boys were more likely than girls to be diagnosed as having severe or extremely severe problems. Whites and Indians/native Americans were most likely to be diagnosed as having mild problems. Students with Spanish surnames and blacks were most likely to be diagnosed as having severe problems, blacks especially so.

Student performance on the math test reflected the accuracy of the teacher and specialist diagnosis--mild to extremely severe.

c. Participation in Corrective/Remedial Math Programs.

Approximately 12 percent of the Oregon fourth graders sampled were participating in corrective/remedial math programs. This group looked much like the group described as having math problems. In addition, these students in remedial programs tended to be in smaller classes and using concrete, manipulative objects during their math instruction.

Students participating in their remedial programs performed well below the state average. This indicates that they have been correctly placed. However, it is important to note that the data does not indicate in any way the effectiveness of these programs. This could only be determined by evaluation of the individual remedial programs themselves.

d. Receiving (Not Receiving) Corrective/Remedial Help in Math

Of those fourth graders sampled, eight percent were described by teachers as needing remedial help but not getting it.

e. Diagnosis of Reading Problem.

Student performance on the math assessment varied directly with the severity of the reading problem identified by the teacher. In other words, the more severe the student's diagnosed reading problem, the lower his/her math performance was. Reading difficulties may be precluding mathematics performance.

f. Diagnosis of Both Math and Reading Problems.

Fourteen percent of sampled fourth graders had been described by teachers as having problems in both math and reading. These students scored substantially below the state average on the math test. Generally, students diagnosed as having a mild problem in math also had a mild problem in reading. This direct relationship held true at all levels of severity.

2. Math Program/Teacher Characteristics

a. Time Per Day In Math Instruction.

Teachers were asked to indicate for each student the average amount of time per day spent receiving formal instruction in math skills or concepts. The results were as follows:

Number of Minutes Per Day	Percent of Students
16 - 30 minutes	12 percent
31 - 45 minutes	50 percent
46 - 60 minutes	32 percent

There were no performance differences among students in the above three categories. However, students receiving math instruction for 15 minutes or less per day were generally above the state average, while students receiving over 60 minutes per day were generally below the state average. The latter tended to be diagnosed as having severe math problems and in remedial programs.

b. Size of Math Class.

Performance by students in math classes consisting of 10 or fewer students and of 11 to 15 students was somewhat below the state average. Students in these smaller class sizes were somewhat more likely to have been diagnosed as having math problems. They were also more likely to be in remedial math programs and belong to minority groups.

Of those Oregon fourth graders sampled, 56 percent received their math instruction in classes ranging from 16 to 25 students in size.

c. Use of Concrete, Manipulative Objects.

Performance results indicate that students who never used concrete, manipulative objects in their math instruction achieved above the state average, while students who often or very frequently used such objects performed below the state average. Manipulative objects appear to be used in remediation with particular types of students: those having math problems and those in corrective/remedial math programs and those who are members of minority groups.

d. Teacher Preservice/InService.

Approximately half of the fourth graders sampled had teachers who had received either preservice or inservice training in mathematics or mathematics teacher techniques within the past two years. Students whose teachers had received training did no better than students whose teachers had not.

This information does not, in any way, invalidate preservice/inservice experiences for it was not possible to gather information on the type or quality of such experiences.

3. Student Characteristics

a. Sex of Student.

Student performance differences between boys and girls were slight. Girls performed only slightly better than boys in four of the five content domains: geometry; arithmetic; numeration, variables, and symbols; probability and statistics. Boys performed slightly better than girls in the measurement domain.

b. Repeating a Grade.

Fourth graders who had not previously repeated a grade performed above the state average, regardless of age. Repeaters ten years of age and older were consistently below the state average and they were more likely than nonrepeaters to have been diagnosed as having math problems.

c. Race/National Origin of Student.

The student performance of four racial/national origin groups was examined. White students scored slightly above the state average, native Americans slightly below, Spanish surnamed students were somewhat farther below and blacks were extremely below the state average. A higher percentage of blacks than of any other group were participating in corrective/remedial math programs or ESEA Title I programs.

d. Students New To a District.

Performance results indicate that new students, constituting 15 percent of the sampled fourth graders, were only slightly below the state average. These students as a group did not show great deficiencies in math skills and concepts.

e. Bilingual Students.

Those bilingual students who performed most poorly were those who agreed with their teachers that they spoke a second language. These were also the students whose bilingualism, according to the teacher, had created a learning problem.

4. District Characteristics

Variables such as region, district per pupil expenditure, and district size were selected not so much because large performance differences were expected, but because these variables helped insure a representative sample of schools across the state.

a. Region.

Regions of the state were defined in the same manner as in the 1975 reading assessment. The eastern* region included the 18 counties east of the Cascade Mountains; the western* region consisted of the 15 counties west of the Cascades but excluding the Tri-County Metropolitan region. The Tri-County Metropolitan region included Multnomah, Washington, and Clackamas Counties.

The eastern and western regions each had statistically significant scores above the state average in one domain. The Tri-County Metropolitan region had statistically significant scores below the state average in four domains. In all cases the regional differences tended to be very small, hence making their educational significance questionable.

b. District Per Pupil Expediture.

This was the district's average per pupil expenditure (federal, state, or local) for classroom instruction and school administration. Per pupil expenditure covers funds spent on all educational activities and materials, not just those directly related to math instruction.

Three per pupil expenditure categories were used: $799 or less, $800-999, and $1,000 or more. Statistically significant differences in student performance for each level were small. The students whose districts were in the $799 or less category were slightly above the state average in one of the five content domains, while students whose districts fell into the $800-999 category were below in two. Students whose districts fell into the $1,000 or more category were right at the state average.

c. District Size.

District size was defined as the total number of public school students, not just fourth graders, in the district. Four categories were established: 1-99 students; 100-2,999 students; 3,000-7,499 students, 7,500 or more students. No performance differences were observed among any of these categories for any of the content domains.

*Eastern: Baker, Crook, Deschutes, Gilliam, Grant, Harney, Hood River, Jefferson, Klamath Falls, Lake, Malheur, Morrow, Sherman, Umatilla, Union, Wallowa, Wasco, Wheeler.

*Western: Benton, Clatsop, Columbia, Coos, Curry, Douglas, Jackson, Josephine, Lane, Lincoln, Linn, Marion, Polk, Tillamook, Yamhill.

RECOMMENDATIONS ON THE INTERPRETIVE PANEL BASED UPON ANALYSIS OF CONTENT DOMAINS AND REPORTING VARIABLES

The interpretive panels composed of Oregon citizens and educators developed a number of recommendations based upon their analysis of the content domains and reporting variables. These recommendations, formulated independently of the Oregon Department of Education staff, were specifically directed to those bodies and groups capable of playing a major role in improving fourth grade mathematics education in Oregon.

TO THE OREGON LEGISLATURE:

1. That funds be provided to develop corrective/remedial programs for those students diagnosed as needing them and not now receiving them.

2. That the Oregon Department of Education be provided the financial support adequate for the development of appropriate mathematics materials, resources, and inservice training, as well as significant mathematics-related studies.

3. That the tasks recommended below for Oregon Department of Education implementation be closely monitored.

TO THE STATE BOARD OF EDUCATION AND THE OREGON DEPARTMENT OF EDUCATION

1. That the Department undertake a study focusing on the mathematics skills of minority children to determine factors which may contribute to lower performance by these children.

2. That the Department of Education undertake studies into the relationship between the use of manipulative objects in mathematics instruction and student performance in mathematics.

3. That information be systematically provided, including support materials and method aids, in the areas of: (1) metrics, (2) the application of geometric principles, (3) perimeter, (4) realistic money problems, and (5) problem-solving, including word problems.

4. That a research base be identified or developed in the area of word problems (one type of problem-solving) to design guidelines for improving student mathematics performance in Oregon.

5. That specific in-service offerings be developed to help teachers foster the use of math in solving everyday problems.

6. That assessment in basic skill areas be continued.

7. That assessment results be used to assist colleges and universities in reviewing teacher prepartion programs, for the purpose of developing curricula which contain training in metric systems in particular and measurement in general.

TO THE STATE TEXTBOOK COMMISSION AND LOCAL TEXTBOOK COMMITTEES:

1. That materials adopted in fourth grade mathematics emphasize the metric system and provide for activity-oriented learning experiences in areas such as (a) measuring, (b) finding perimeter, (c) constructing graphs, (d) shopping and dealing with money. Furthermore, the materials should treat geometric shapes and properties, including application skills, as developmental portions of the curriculum.

2. That activity-centered and hands-on experiences be emphasized in the foregoing areas and related curricular materials be considered for adoption.

TO LOCAL EDUCATION BOARDS AND AGENCIES

1. That practical hands-on experience be provided in teaching mathematics and that math labs be developed with adequate resources and staff.

2. That remedial/corrective programs be made available to all students with diagnosed learning problems.

3. That alternative programs be explored as a means for improving the performance of students who are repeating grades and that students who are repeating grades be provided new instruction with new materials, rather than be re-exposed to the same material.

TO TEACHERS AND DISTRICT PERSONNEL (counselors, curriculum directors, principles)

1. That reading and mathematics instruction be coordinated.

2. That the development of mental computation and estimation be fostered in addition to paper-and-pencil computations.

3. That appropriate instruction focus on helping students solve "real world" math problems, where there may be too much, too little, or just the right amount of information.

4. That the use of concrete objects be explored in teaching concept development to all students and that the use of concrete objects in remediation be continued.

5. That methods be explored and developed for additional instruction in such basic mathematical skill and concept areas as place and numerical value, regrouping, the concept of zero, number patterns, ordering of numbers, and subtraction facts.

6. That the maintenance of addition and subtraction skills acquired earlier be fostered by constant review on a regular basis.

7. That current emphasis on multiplication skills be continued in the fourth grade.

TO PARENTS AND CITIZENS:

1. That the instruction of children be aided by parents in everyday activities; that children be given the opportunity to learn budget preparation, comparison shopping, and the making of change.

2. That children be helped to understand the uses and misuses of the calculator in dealing with arithmetic problems; that calculators are real life aids used in computations where speed and accuracy are important, but that individuals should possess an understanding of math principles and a demonstrable ability to perform arithmetic computations before reliance is placed on computations with the calculator.

3. That families prepare together for the transition to the metric system.

LIFE ROLE AND INSTRUCTIONAL AREA CLUSTERS - INTERPRETATIONS AND RECOMMENDATIONS

On June 23, 1976, the State Board of Education officially adopted a set of Minimum Standards for Public Schools. In the Standards the Board set forth six major goals for public schools (OAR 581-22-201)*. These goals are intended to insure that every student has the opportunity to "learn to function effectively in six life roles: INDIVIDUAL, LEARNER, PRODUCER, CITIZEN, CONSUMER, and FAMILY MEMBER. Each goals suggests . . . knowledge, skills, and attitudes needed to function in these life roles." Local districts are required to implement the six statewide goals through the development and implementation of their own district goals, program goals, and course goals. Local districts are also required (OAR 581-22-208) to adopt procedures to assess reading, writing and/or computing skills as they are developed or applied in instructional program areas.

The Minimum Standards will require districts to focus on curriculum questions different from those that traditionally have been addressed. For example, are different levels or different kinds of reading skills needed to be a successful "consumer" as opposed to being a successful "family member"? Are different math or writing skills related to success in science programs as opposed to social studies or art programs? Do the basic skills differ as they relate to different subject matter or life role areas? If so, how do they differ? These curriculum questions and many related ones will make new demands on assessment to provide valid information upon which good policy decisions may be based.

With these considerations in mind, and with the results of the math assessment in hand, the Department decided to re-examine the data to help determine the directions future statewide assessment efforts might take. The discussion which follows is an attempt to share the results of what might be considered a feasibility study. Bear in mind that the fourth grade math test was not designed with this purpose in mind. If the data are not "bent," they are "stretched" at least to help clarify some new ideas.

The logic of this new look at the assessment data is straightforward. If the items on the test are an adequate sample of the behavior described by the 28 performance indicators and if the performance indicators identified by the first content panel adequately represent the five domains used by them to describe the fourth grade math curriculum, then the items on the test should provide a fairly accurate representation of what the fourth grade mathematics curriculum is all about. If one accepts this line of thought, it becomes useful to see if certain groups of items on the test might relate well to certain life roles or instructional areas. If, in fact, such relationships exist, the performance of the students on these groups of items can then be examined.

A second panel, consisting of 15 content specialists, public school teachers and administrators, was invited to participate in the ensuing discussions. At the first meeting, on October 14, 1976, the group considered each of the items on the math assessment instrument. The

*Elementary/Secondary Guide for Oregon Schools, Part I: Minimum Standards for Public Schools.

items were classified in terms of their relevance to different instructional areas and life roles. Of course, many items--interpretations of graphic information, for example--were judged to be relevant to several different areas. This procedure resulted in the identification of "clusters" of items relating to eight instructional areas (in addition to math itself) and three life roles. These reduced to only two life role clusters since the panel decided that all items could be related to the role of "life long learner."

Since the whole set of items had been previously reviewed by another panel, the group felt there was no need for further analysis of the "math" and "learner" clusters. In addition, so few items were judged relevant to the "individual," "producer," and "family member" life roles that it was not considered worthwhile to attempt an analysis in these areas.

Before the panel met again November 8 and 9, the assessment results were reanalyzed and performance on items summarized in each of the ten cluster areas. At the meeting individual panelists were assigned to one of two groups according to their areas of specialization. These groups reviewed the student performance data for items in clusters relatd to their special interests. They then prepared interpretations and recommendations.

Each group addressed four study areas and one life role in its deliberations. Group 1 focused on the study areas of language arts, career education, art, and consumer education/personal finance and the life role of "consumer." Group 2 focused on social studies/history, physical education/health, science and citizenship and life role of "citizen."

Group 1 Interpretations and Recommendations

Area of Study Cluster - Language Arts

INTERPRETATIONS

Of those items identified as having a relationship to language arts, students generally displayed higher performance on items dealing with form perception (performance indicators 1, 2, 4, and 5) than on items dealing with reasoning: e.g., word problems plus graph interpretation (performance indicators 13, 14, 26, 27 and 28). Lower performance on the latter items could possibly be attributed to some of the following factors:

a. Test items depended heavily upon reading skills.
b. Test items were inappropriate for fourth grade level.
c. A need for change in instructional emphasis exists.

For the above reasons and the limited amount of data, further interpretations for the language arts cluster cannot be undertaken.

Area of Study Cluster - Career Education

INTERPRETATIONS

In the judgment of the panel, the performance indicators identified as having a relationship to career education did not adequately represent the math skills considered to be most critical for a study in a career education program. Hence, the following interpretations lack comments on some critical performance indicators not identified for review by the panel.

Of those performance indicators reviewed by the panel, the following were considered most important to success in career education: solving word problems, ordering numbers, interpreting graphs, knowing the limitations of graphs, and making bar graphs. Performance on the corresponding items appeared to be consistently lower than expected or desired. Such deviations could possibly be explained by any of the following:

a. If items assessed reading skills more than math skills.
b. If these skills did not receive enough emphasis within the math curriculum.

Area of Study Cluster - Art

INTERPRETATIONS

Items corresponding to the following performance indicators were identified as sharing a strong relationship with skills essential to art:

Performance Indicator 1: Geometric Concept Identification
Performance Indicator 2: Figure Similarities
Performance Indicator 3: Figure Differences
Performance Indicator 4: Matching Shapes
Performance Indicator 5: Shapes in Nature

Student performance was found to be quite good.

Area of Study Cluster - Consumer Education/Personal Finance

INTERPRETATIONS

The panel identified items corresponding to the following performance indicators as having the most direct relationship to the application or development of math skills in the consumer education/personal finance area of study:

Performance Indicator 10: Adding, Subtracting Money
Performance Indicator 14: Shopping - Add, Subtract
Performance Indicator 18: Correct Equation Identification
Performance Indicator 21: Coin Names, Values
Performance Indicator 22: Change on Purchase
Performance Indicator 25: Exact Money Amount

Of equal importance, but viewed as prerequisite skills were performance indicator 8: Multiplication Basic Facts and performance indicator 9: Adding, Subtracting. While student performance was judged adequate on the items corresponding to performance indicators 8 and 21, the performance on values for items corresponding to performance indicators 9, 10, 14, 18, 22 and 25 was questionable. These lower performance values could possibly be explained by reasons other than inadequate preparation of students, e.g., confusing test item structure or test items above fourth grade level of difficulty.

Life Role Cluster - Consumer

Since the consumer education/personal finance areas of study was developed in alignment with the consumer life role, the panel viewed the skills required as nearly identical. In accordance, those math skills considered critical for the consumer life role were identical to those considered critical for the consumer education/personal finance area. Consequently, the interpretations and recommendations for the two were also identical.

Group 2 Interpretations and Recommendations

Area of Study Cluster - Social Studies/History

INTERPRETATIONS

Of those math skills measured by items on the Fourth Grade Statewide Math Assessment, the following skills may be important to achievement in the social studies and history areas.

a. Word Problems (Addition, Subtraction)
b. Interpreting Graphs
c. Knowing Graph Limitations
d. Making Bar Graphs

In the panel's opinion, fourth grade student performance, as revealed by the item performance values was not adequate in two skill areas: Word Problems and Making Bar Graphs.

Area of Study Cluster - Physical Education/Health

INTERPRETATIONS

Of those math skills measured by items on the Fourth Grade Statewide Math Assessment, the following skills may be important to achievement in the health and physical education areas:

a. Adding and Subtracting
b. Word Problems
c. Interpreting Graphs
d. Knowing Graph Limitations
e. Making Bar Graphs

The panel found the performance values for the above skills to be somewhat low. It chose not to comment on student performance, however, since the assessment instrument had not been designed to assess these areas.

Area of Study Cluster - Science

INTERPRETATIONS

Of those math skills measured by items on the Fourth Grade Statewide Math Assessment, the following skills may be important to achievement in the science area:

a. Figure Similarities
b. Figure Differences
c. Matching Shapes
d. Shapes in Nature
e. Multiplication Basic Facts
f. Adding and Subtracting
g. Word Problems (Adding and Subtracting)
h. Math Symbol Identification
i. Ordering Numbers
j. Length Measuring Units
k. Volume of Rectangular Solid
l. Interpreting Graphs
m. Knowing Graph Limitations
n. Making Bar Graphs

Fourth grade student performance, as revealed by the item performance values, was judged inadequate in Subtraction, Word Problems, Ordering Numbers, and Volume of Rectangular Solid. Student performance was generally considered acceptable on the remaining skills listed.

Area of Study Cluster - Citizenship

INTERPRETATIONS

Of those skills measured by items on the Fourth Grade Statewide Math Assessment, the following skills may be important to achievement in the citizenship area:

a. Word Problems
b. Interpreting Graphs
c. Knowing Graph Limitations

Student performance on those math skills was considered generally acceptable for the specific test items.

Life Role Cluster - Citizen

The desired performance indicators in the citizen life role need to be clarified. Until then the panel members feel unable to identify which math skills may be important for success in the citizen life role.

INTERPRETATIONS

None are possible until the citizen life role has been clarified.

RECOMMENDATIONS

After identifying the items which related to the areas of study and life role clusters just discussed and interpreting student performance in each subject, the two groups made certain recommendations. Since they had decided that the math assessment instrument had not adequately measured all the math skills related to achievement in language arts, career education, consumer education/personal finance, social studies/history, physical education/health or citizenship, they recommended that (1) an analysis of the math skills needed in each area be done, and (2) that an instrument appropriate to each area be developed.

Group 1 members felt that the math assessment instrument had adequately assessed the math skills needed for art. They did recommend, however, that certain items be examined again in terms of their level of difficulty for fourth graders. (The items seemed to be too easy for fourth grade students.)

Group 2 members decided that the math skills necessary to learn fourth grade science lessons were assessed fairly well by the math assessment instrument. It was their opinion, however, that a better instrument could be designed.

APPENDIXES

APPENDIX A

STATEWIDE ASSESSMENT MATH DOMAINS AND PERFORMANCE INDICATORS

DOMAIN I. GEOMETRY SKILLS (7 Performance Indicators, 19 Test Questions)

Those skills involving the properties and relationships of points, lines, angles, surfaces, and figures (triangles, circles, rectangles). Included here is the identification of geometric concepts; recognition of similarities and differences among figures; and the relating of geometric models to the physical world.

Performance Indicator Number 1: Given the name, the student will match the name to its appropriate pictorial representation. (GEOM CONCEPT IDEN)

a. point	f. triangle
b. line	g. circle
c. curve	h. cube
d. square	i. square corner
e. rectangle	j. right angle

Performance Indicator Number 2: Given pairs or sets of geometric figures, the student will identify similarities among the figures, such as number of sides, presence or absence of curved boundaries, equal angles, etc. (FIGURE SIMILARITIES)

Performance Indicator Number 3: Given pairs or sets of geometric figures the student will identify differences among the figures, such as size, shape, number of sides, etc. (FIGURE DIFFERENCES)

Performance Indicator Number 4: Given several figures, the student will identify which are the same shape, regardless of size. (MATCHING SHAPES)

Performance Indicator Number 5: Given examples in nature, the student will identify and name similarities to geometric figures in each example. (SHAPES IN NATURE)

Performance Indicator Number 6: Given examples of construction (buildings, etc.), the student will identify and name similarities or relationships to geometric figures in each example. (MAN-MADE FIGURES)

Performance Indicator Number 7: Given the length of two adjacent sides of a rectangle, the student will find its perimeter. (FINDING PERIMETER)

DOMAIN II. ARITHMETIC SKILLS (7 Performance Indicators; 29 Test Questions)

Those skills dealing with the basic operations (addition, subtraction, multiplication, division) performed on numbers. Arithmetic skills

include adding/subtracting whole numbers and money values; doing simple multiplications; knowing multiplication properties; and using the basic operations of addition, subtraction, multiplication, and division to solve story problems.

Peformance Indicator Number 8: Given pairs of numbers where a< 5 and b< 10, the student will give the products of a and b. (MULT BASIC FACTS)

Performance Indicator Number 9: Given two 2-digit or 3-digit numbers using vertical or horizontal forms, the student will find the sum or difference with or without regrouping. (ADDING, SUBTRACTING)

Performance Indicator Number 10: Given two money values, the student will add or subtract using dollar and cents notation with or without the use of aids. (ADD, SUBTRACT MONEY)

Performance Indicator Number 11: Given two numbers to multiply, the student will indicate that the product obtained for the two numbers is the same regardless of their order. (NUM ORDER IN MULT)

Performance Indicator Number 12: Given a multiplicative problem the student will determine those answer that are not possible. (IMPOSSIBLE PRODUCTS)

Performance Indicator Number 13: Given any one-step word problem containing sufficient information and involving the addition or subtraction of integers (or whole numbers), the student will set up the problem, solve it and show his work. (WORD PROB--ADD, SUB)

Performance Indicator Number 14: Given an item or a list of items to buy, and a list of stores with their prices for the item(s), the student will indicate which store(s) have the best buy on each item and which store has the overall best buy. (SHOPPING--ADD, SUB)

DOMAIN III. NUMERATIONS, VARIABLES, AND SYMBOLS SKILLS (6 Performance Indicators, 23 Test Questions)

Those skills involving the objects and representations (numbers, variables, symbols) of mathematics. Included here is the identifying of math symbols (+, -, ÷, =); recognizing place values; ordering numbers, identifying odd and even numbers; and selecting appropriate mathematical sentences.

Performance Indicator Number 15: Given the symbols +, -, x, ÷, =, ≠, >, <, the student will correctly indicate their meanings and vice versa. (MATH SYMBOL IDENT)

Performance Indicator Number 16: Given a set of five different counting numbers less than 1,000, the student will arrange them from smallest to largest. (ORDERING NUMBERS)

Performance Indicator Number 17: Given any numeral less than 1,000,000, the student will assign the correct place value names to the digits. (PLACE VALUE)

Performance Indicator Number 18: Given a problem, the student will write an equation that correctly depicts the problem. (CORRECT EQUAT IDEN)

Performance Indicator Number 19: Given the first few (as necessary) elements from the whole numbers in a correct number pattern, the student will correctly give the next three elements. (WHOLE NUM PATTERNS)

Performance Indicator Number 20: Given any counting number less than 1,000 the student will indicate whether it is even or odd (i.e., has a factor pair containing two). (ODD, EVEN NUMBERS)

DOMAIN IV. MEASUREMENT SKILLS (5 Performance Indicators, 16 Test Questions)

Those skills dealing with the assigning of numbers to the properties of objects. Measurement skills include selecting appropriate units of length; determining volume (cubic units) of solids; knowing the value and names of coins; and understanding monetary units in completing transactions.

Performance Indicator Number 21: Given a U.S. coin with a denomination of one dollar or less the student will name the coin and state its value in cents or in terms of other coins (e.g., 1 quarter = 25 cents or 1 quarter = 5 nickels). (COIN NAMES, VALUES)

Performance Indicator Number 22: Given a total purchase value less than $20, the student will indicate the proper change. (CHANGE ON PURCHASE)

Performance Indicator Number 23: Given examples of different objects whose length or distance is to be measured, the student will select the appropriate unit from inches, feet, yards, miles (or from centimeter, meter). (LENGTH MEAS UNITS)

Performance Indicator Number 24: Given a rectangular solid marked off in unit cubes, the student will state the volume of the solid in unit cubes. (VOL OF RECT SOLID)

Performance Indicator Number 25: Given the price of an object, the student will give a combination of U.S. coins and/or bills that would be the exact amount for the purchase of the object. (EXACT MONEY AMT)

DOMAIN V. PROBABILITY AND STATISTICS SKILLS (3 Performance Indicators, 13 Test Questions)

Those skills involving the use of statistical concepts. Included here is the interpretation of data from pie charts, bar graphs, and pictographs; knowing the limitations of graphs; and the recording of information in a bar graph.

Performance Indicator Number 26: Given charts or graphs, the student will be able to interpret the data. (INTERPRET GRAPHS)

Performance Indicator Number 27: Given data and a graph, the student will determine if the data lies within the limitations of the graph. (GRAPH LIMITATIONS)

Performance Indicator Number 28: Given selected information (relative heights, temperatures, spelling scores, etc.), the student can record the information using a bar graph. (MAKING BAR GRAPHS)

APPENDIX B

Area of Study Clusters and Related Performance Indicators

Given below are the performance indicators assigned to each cluster by the second math assessment panel. Panelists considered performance on the items measuring these performance indicators in making interpretations, recommendations on each cluster.

Cluster	Performance Indicators
1. Language Arts	1*, 2*, 4*, 5, 13*, 14, 26, 27, 28
2. Career Education	1*, 13*, 16*, 23, 26, 27, 28
3. Art	1*, 2, 3*, 4*, 5, 13*
4. Consumer Education/ Personal Finance	7*, 8, 9, 10, 13, 14, 15, 16, 18*, 21, 22, 23, 25, 26, 27, 28
5. Social Studies/History	13*, 26, 27, 28
6. Physical Education/Health	9, 13*, 26, 27, 28
7. Science	2*, 3*, 4, 5, 8, 9, 13*, 15, 16*, 23*, 24, 26, 27, 28
8. Citizenship	13*, 26, 27
9. Consumer	7*, 8, 9, 10, 13*, 14, 15, 16, 18*, 21, 22, 23, 24*, 25, 26, 27, 28
10. Citizen	26, 27

*Panelists did not believe all items within this performance indicator were related to the cluster.

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